Weekly Homework 11.11.2021

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Learn to Code

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Do: Install R and RStudio (newest version), read about the syntax in the given book and make yourself acquainted with data structures, operations (if/else, for-loop, while-loop, access, insert, remove, change). Use a book about algorithm design in order to learn about concepts like data structures and efficient algorithms.

Aim: Learn the way to think and work with simple data structures and operations.

Next: Learn to use packages.

Paradigms: **Basic use**, efficient programming, creating clean scripts, creating your first package, data analysis, defensive programming, project workflow, programming in a team.

Golden Future: Apply machine learning algorithms in order to solve problems specific to your field of application so that you can execute a project and present nice results to experts! :-)

Exercise Big O notation (Landau Symbole).

1. Define in your own words what the Big O notation means
2. What is the difference between the complexity of a data structure and operations/algorithms/...
3. What is the complexity to save following structures (Note, that here only general concepts are meant, no usage of sparse or similar methods of compression)
   (a) Vector/Array
   (b) Matrix/Table
   (c) Tree
   (d) Graph with N Vertices and E edges
4. What is the complexity of following algorithms:
   (a) Merge Sort
   (b) Quick Sort
   (c) Bubble Sort
   (d) Matrix multiplication

5. What is the difference of the runtime between a for-loop and a vectorized function (e.g. lapply). Why is it different? (Save this one for later)

6. What concept is exploited when parallelizing code? (Later)

7. How much speed-up can be expected from parallelization? (Later)

Exercise Sort. Choose a sorting algorithm by your choice (recommended: merge or quick sort, you can also try bubble sort or an other sort algorithm made for a vector if you want). Now, implement the algorithm in R with any help of the following:

1. Noob: Get R-Code from `http://www.rosettacode.org/wiki/Rosetta_Code`

2. Advanced: Get non-R-Code from `http://www.rosettacode.org/wiki/Rosetta_Code`

3. Expert: Get Pseudo-Code or any other similar instruction from books or wikipedia

Use the found instructions to implement your own algorithm. For those who use code from another language, try to step through the algorithm and understand its workflow and imitate it in R. The advanced option is probably the best way to learn and the way to go!

Exercise Strassen-Matrix-Multiplication. Implement your own matrix multiplication in a similar way as in the exercise before!